PEST MANAGEMENT GRANTS FINAL REPORT

Training Scouts and Developing Demonstration Sites to Promote Floriculture IPM Programs

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DISCLOSURE

The statements and conclusions in this report are those of the contractor and not necessarily those of the California Department of Pesticide Regulation. The mention of commercial products, their sources, or their use in connection with material reported herein is not to be construed as actual or implied endorsement of such products.

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ABSTRACT

Cooperating farm advisors in three ornamental production regions set up demonstration plots and trained employed scouts in each area. These scouts were responsible for pest monitoring, record-keeping, and weekly meetings with growers to make pest management decisions based on the information collected. The monitoring procedures were used to incorporate IPM methods that minimized pesticide use, including the use of plant samples, sticky traps, pheromone and other attractant traps as appropriate. In addition, the use of biological control was implemented where feasible, and petunia indicator plants were used for monitoring tospoviruses. Records were kept of the amounts and choices of pesticides and beneficial insects used, and the complete costs associated with the program. Comparisons were made between the IPM treatments vs. the growers' conventional pest control practices. Results indicate that the monitored areas using IPM techniques received reduced amounts of pesticides with no negative effects on plant quality. This was usually achieved at a lower over-all cost, even with the increased labor for monitoring. Because of the benefits of the IPM programs, most grower-cooperators have continued the scouting programs after project completion. The information gleaned from the demonstrations was extended in numerous presentations and publications, and in nine training workshops held in 1998.

EXECUTIVE SUMMARY

The major objective of this project was to demonstrate to California flower growers that they can decrease pesticide usage, maximize economic returns, and produce high quality crops by using IPM programs which use established scouting procedures. To accomplish this goal and increase adoption of scouting programs in commercial settings, demonstration plots were set up in three ornamental production regions in 15 nurseries by the cooperating farm advisors and scouts trained by these advisors. These IPM programs were designed to incorporate the use of biological control agents and the use of petunia plants as indicators of tospoviruses where feasible. Over 100 different flower crops were examined, and biological control programs were implemented on four of them. Monitoring took place at least once per week at each site and included the use of plant samples, sticky traps, pheromone and other attractant traps as appropriate. In addition, petunia indicator plants were used for monitoring tospoviruses in lisianthus, snapdragons, chrysanthemums, ranunculus, kalanchoe, begonia, and cyclamen. Sampling strategies were developed during the initial demonstration period to determine the minimum number of plants and traps necessary to obtain sufficient information concerning population trends at a reasonable cost.

Scouts met weekly with the growers/pest management decision-makers. These face-to-face meetings not only were necessary to discuss the crop status and ascertain required control measures, but also to demonstrate the results and benefits of the program to the nursery cooperators, and ensure that they were sufficiently trained to continue the program when the project was completed. Pest management actions were based on the monitoring data. Whenever possible, reduced-risk pesticides, use of natural enemies, and biopesticides were used over conventional pesticides such as organophosphates, carbamates and EPA category B2 fungicides.

Records were kept of the amounts and choices of pesticides and beneficial insects used, and the costs associated with the program. The cost and quality of the IPM/scouting program was then compared to conventional programs. We demonstrated the superiority of the IPM programs in many situations. Growers benefited from reduced pesticide use, lower production costs, and higher quality and yield. As a result, most have continued scouting after project completion.

In addition to the demonstrations, nine regional scouting training workshops were held in 1998, reaching an audience of over 300. Each workshop session was limited to 35 participants so that hands-on learning was fostered. Four of the workshops were conducted in Spanish, as well as English. Sixty of the most common pests and natural enemies of floricultural crops were collected, mounted, preserved, and labeled. A set of these collected insects was used at the training meetings along with fresh material. In addition to bilingual materials previously developed for training workshops, publications were developed on scouting techniques and on tospovirus monitoring; an insect manual was revised.

Articles were disseminated in newsletters and trade magazines, and a poster was presented to growers. A sign about the project was developed and is currently on display in flower fields, where it is viewed by the general public, as well as by growers. Many statewide, regional and national presentations were made. A survey was developed and disseminated at the scouting training meetings. Survey results indicate that the project has been highly successful in making changes in the industry in pest management practices, and has resulted in over-all reduction in pesticide use.

BODY OF REPORT

INTRODUCTION

Background, Assumptions, and Problems Addressed

As a result of the common occurrence of crop infestation and because of the low tolerance for damage, ornamental crops receive more frequent applications of pesticides than any other agricultural crop. It is estimated that 7.9 million pounds (active ingredient) of insecticides and fungicides are used each year in greenhouse sites in California (1995 Pesticide Use Report, California Dept. Food and Agriculture). This has led to worker safety and environmental contamination issues. At one time these high input/high value crops were not considered by growers to be good candidates for IPM, and they were more comfortable with calendar applications of pesticides. A great deal of research on IPM strategies for ornamental crops has helped to change this perception. Insecticide resistance and increasing regulations have also been a factor in this changing view. Currently, however, many growers are still using a hit or miss strategy in utilizing pest control options. Timing of pesticide applications is often mismanaged. Pesticides are frequently not applied until populations are too high, or are applied when pests are not present. Because immature stages of insects such as whiteflies and leafminers are not monitored, adulticides are often misused.

The basic assumption of this project, based on previous work by the authors and others, is that scouting programs assist growers in the adoption of pest management practices that are more environmentally friendly and safer for workers, consumers and the community at large.

Defining and refining pest action levels through regular scouting programs was a major focus of this project. Regular monitoring is the framework of good IPM programs. The backbone of a good IPM program is the scout who gathers pest information about the crop. The scout looks regularly for pests and plant abnormalities, records what is found, summarizes this information and reports it to the grower for the final pest management decision.

Scouts need to be trained to know what to look for and how to evaluate IPM programs. One goal of this project has been to provide training for growers, professional pest management personnel, pest management workers, and others interested in scouting programs. Due to the nature of the work force involved in pest management practices in California nurseries, we felt that these workshops needed to be hands-on and provided in English and Spanish to be effective.

A major obstacle to reducing over-reliance on conventional pesticides in flower production has been the lack of effective alternatives for controlling major pests. One potential solution is the development of 'biorational' or reduced-risk pesticides that lack many of the undesirable secondary effects of conventional pesticides. The Food Quality Protection Act (FQPA) of 1996 brought about many changes that favored the development and registration of reduced risk pesticides. As a result, new reduced risk materials labeled for greenhouse use have come on the market in the past two years. For example, a microbial fungus, *Beauveria bassiana* (Botanigard, Mycotech Corp.) has been shown to successfully control thrips, whiteflies and aphids. However, it is difficult to incorporate the use of biological control and slower-acting reduced-risk pesticides without a monitoring program in place.

Scouting is not a static system and does not operate in a vacuum. Techniques will improve with continued fundamental research. The purpose of our project has been to allow growers to utilize the most current scouting information available based on fundamental research, such as the use of petunia indicator plants for monitoring thrips carrying tospoviruses. Moreover, growers who are already experienced with scouting and IPM programs are better equipped to adopt and implement new scouting techniques as they become available.

Purpose and Objectives

(1) To demonstrate to flower growers the benefits of on-site monitoring of pest and beneficial organism populations as well as important environmental variables for proper pest and disease identification, accurate knowledge of pest and disease population levels, and awareness of pest and disease biology for maximum management during all phases of production.

(2) To use established monitoring procedures and thresholds to minimize pesticide use and achieve control with the least possible harm to human health, nontarget organisms, and the environment, involving the use of biological control agents, biopesticides, and reduced risk pesticides as an alternative to conventional pesticides such as organophosphates, carbamates and EPA category B2 fungicides.

(3) To demonstrate through economic analyses that the cost of IPM programs based on monitoring and reduced risk management are often more than offset by decreased pesticide usage and better quality crops.

(4) To increase the adoption of the use of IPM and reduced risk management practices and foster a team approach to scouting by extending the information learned from this project to nursery workers as well as owners/managers, pest control advisors and others interested in IPM programs.

(5) To evaluate the adoption and understanding of IPM and reduced risk management techniques of growers involved in the demonstrations and workshops.

(6) To provide training for farm advisors on the latest monitoring techniques so that they can extend this information to clientele and work more effectively at demonstration sites.

Previous Related Work

*Sampling Methods for Floriculture Crops***.** There has been a great deal of research on improved sampling methods for ornamental crops and IPM strategies (Heinz et al. 1988 and 1992, Hesselein et al. 1993, Karlik et al. 1995, Parrella et al. 1989, and Sanderson and Zhang 1995). Previous floriculture IPM research has focused most extensively on insect pests of two important crops, chrysanthemums (Heinz et al. 1993, Hesselein et al. 1993, Parrella et al. 1992b, Robb and Parrella 1995) and poinsettias (Ferrentino et al. 1993; Hausbeck 1995; Heinz and Parrella 1994; Parrella 1995, 1992a, and 1992b; Sanderson and Ferrentino 1993). The results of these research trials have underscored the need for establishing a scouting program and defining and refining pest action thresholds for target pest problems. Moreover, there are so many ornamental crops produced in California that this research has only touched the tip of the iceberg. Further research is needed on other crops.

Use of Petunia Indicator Plants. Petunia has been shown to serve as a good indicator of tospovirus infection (Allen and Matteoni 1991). Petunia indicator plants develop a brown or black lesion on their leaves within 3-7 days of an infectious thrips feeding. These are easy for scouts to recognize and are visible more quickly than symptoms on most crop plants. Indicator plants that have been strategically placed signal areas to examine for sources of the virus and the infectious thrips. If a source is located, its prompt removal will help reduce movement of the virus.

Data from a preliminary trial conducted by Ullman and Robb with a grower in San Diego County demonstrated that petunia indicators were useful in identifying the sources of infestation. The source of infestation was determined to be *Malva* weeds in an adjacent field. Once these weeds were eliminated, there was a drastic reduction in disease incidence in the crop.

Currently, there are many California growers who have problems with tospoviruses but few are aware of the use of petunias as indicator plants. Most send their samples to commercial laboratories or rely on recognition of plant disease symptoms. By the time they do this, the disease has already spread. There are kits they can use directly in the nursery, but growers who have used them find them too time-consuming. The advantage of using indicator plants is that the results are apparent very quickly and little technology is required for their use.

Floriculture Scouting Project in California. Our project is an expansion of research originally funded by a UCIPM/Smith-Lever USDA grant and an American Floral Endowment grant to develop scouting demonstration sites. Results from these studies indicate that significant cost savings and reduced pesticide use have been realized by participating growers. Many growers involved have already expanded the program in their operations and pesticide use has declined 40% in some cases (Newman et al. 1996). Another measure of our success is that we had scouts hired away from the University by growers who wanted them as full-time scouts.

Previous experiments have demonstrated the importance of having an established scouting program in place to monitor the efficacy of natural enemies. This allows remedial action to occur in a timely manner, if necessary. As a result of the interest expressed by cooperating growers, we expanded the scope of the original projects to incorporate biological control strategies with growers who have established scouting programs; we also incorporated monitoring for tospoviruses.

This project has not been limited to a few crops. Previously, our research was conducted on greenhouse-grown cut flower and potted flowering crops, field-grown cut flowers and foliage, and container nursery crops. Continuation of the project with additional funding by the CDPR and the American Floral Endowment has allowed us to further expand the scope of plants included in this study to include bedding plants and flower crops grown for seed. Thus, published research results and educational materials developed from the project will have applicability to a greater audience of ornamental producers.

MATERIALS AND METHODS

Objective 1: To demonstrate to California flower growers the benefits of scouting for maximum pest management.

Demonstration plots were set up in three regional flower growing areas by the cooperating farm advisors and by scouts trained by these advisors. Crops scouted were (1) Ventura and Santa Barbara Counties: bedding plants, poinsettias, flower seed crops, cut gerberas, roses, and lisianthus (2) San Diego County: bedding plants, gerberas, poinsettias, begonias, kalanchoe, cyclamen, chrysanthemum, ranunculus, and over 15 container nursery crops, and (3) Santa Cruz County: greenhouse cut gerberas and roses, and over 100 field flower crops. Monitoring took place at least once per week at each demonstration site. The methodology used involved organizing floriculture operations into smaller sections (pest management units), based on the crop, crop cultivar, crop age, greenhouse structure and size, in addition to other pertinent factors. The number of plants sampled from each pest management unit depended on the size of the area, susceptibility of the crop to insects or diseases, and crop value. Emphasis was placed on the need to look at overall plant performance and production methods, since stressed plants, due to improper irrigation, fertilization, lighting, etc., tend to be more at risk for pest attacks than healthy plants.

Monitoring methods included the use of plant samples, sticky traps, pheromone and other attractant traps, as appropriate. Sampling strategies were developed during the initial months of the project to determine the minimum number of plants and traps necessary to obtain sufficient information concerning population trends at a reasonable cost. The scout met weekly with the grower/pest management decision-maker to discuss the crop status and to ascertain any required control measures. In one nursery, since the pest control manager did not speak English, he was provided with personal scouting training conducted in Spanish. We used reduced-risk pesticides and practices over conventional pesticides whenever possible.

Objective 2: To use established scouting procedures and thresholds to introduce the use of biological control agents and the use of petunias as indicator plants for tospoviruses.
We incorporated biological control strategies with grower cooperators who had established scouting programs. Crops included poinsettias, gerberas, lisianthus, and stock. This was compared with the growers' conventional programs to evaluate the feasibility of commercial implementation. We also introduced the use of petunia indicator plants and directional traps for monitoring TSWV and INSV and virus infected thrips in four site locations on lisianthus, chrysanthemums, snapdragons, ranunculus, cyclamen, and kalanchoe.

Objective 3: To demonstrate that scouting programs are economically feasible, decrease pesticide use, and produce high quality crops.
Records were kept of the amount of labor used, amounts and choices of pesticides and natural enemies used, and the quality of crops produced in the scouted plots and in plots representing the growers' standard practices. This information was used to prepare an economic analysis of the program. Information from the scouted IPM areas was compared to information from the areas under the growers' conventional pest management strategies.

Objective 4: To increase the adoption of the use of IPM practices by extending the information learned from this project.
Educational programs were an integral part of this project and a key to the success of adoption of IPM programs on a large scale. Dissemination of information occurred through written articles, field days and workshops. Project activities in 1998 included training for those interested in scouting programs through nine regional training meetings, including workshops at the Society of American Florists (SAF) Conference. Workshops were hands-on and conducted in English and Spanish. These workshops educated growers, PCAs and potential scouts in the areas of pest monitoring methods and identification, pest biology and control options, and identification of abiotic causes of poor plant performance. Resource materials for Spanish speaking clientele were translated. The following resources were developed for use in the workshops and included Spanish and English versions: IPM color poster, disease management manual, mite and insect pest management manual, scouting program description with sample scouting forms, and tospovirus monitoring manual.

At the request of growers, the 1998 scouting workshops provided a more in-depth program on insect identification. Using funding provided by UCIPM/Smith-Lever, more than 60 of the most common pests and beneficials of floricultural crops were collected, mounted, preserved, and labeled. A set was distributed to each cooperating farm advisor and used at the training meetings along with fresh material. We also included information gleaned from the study on monitoring thrips infected with tospoviruses, and provided examples on how biological control can be economically and effectively incorporated into a pest management program.

In addition to the regional scouting training program, the investigators made numerous presentations to California growers, PCAs, and others interested in scouting programs. Presentations were made at regional meetings and at national meetings e.g. the Ohio Florist Short Course 1998 and Bedding Plants Inc. (BPI). A poster on the scouting project was presented at the SAF meeting in San Diego, at the California Association of Nurserymen (CAN) Field Day at UC Riverside, at the CAPCA meeting in Anaheim, at the Pacific Branch Entomological Society of America (ESA) meeting in Hawaii, and at the national ESA meeting in Las Vegas.

Approximately 50 growers toured some of the demonstration sites at the San Diego California Ornamentals Research Federation (CORF) meeting. Articles were disseminated in the CORF newsletters and in UC Cooperative Extension newsletters. Drs. Karen Robb and Diane Ullman published articles in *GrowerTalks* and in *Greenhouse Management and Production* on the use of monitoring to manage tospoviruses.

Recently, we also finished developing the TSWV monitoring publication for use in the 1999 scouting workshops. A sign was developed about the project and displayed in flower fields in Carlsbad where it is viewed by the general public, as well as by growers. The cooperating farm advisors met in October to coordinate articles to be developed for *California Agriculture* and other publications.

Objective 5: To evaluate the adoption and understanding of IPM techniques of growers involved in the demonstrations and workshops.
Impact of the project was measured through records of numbers of growers reached in demonstrations and workshops. A survey was developed to measure adoption of IPM programs and other benefits of the program.

Objective 6: To provide training for farm advisors on the latest monitoring techniques.
Dr. Diane Ullman provided a 2-day training for the cooperating farm advisors at UC Davis on April 23-24. This workshop focused on tospoviruses and the use of monitoring procedures to help farm advisors assist growers in identifying disease sources. Hands-on instruction was provided in the use of the tissue blot immunoassay technique so that farm advisors could do their own testing for tospoviruses. Dr. Ullman and her staff also provided consulting to each advisor to ensure that the plants were utilized to their full potential, and to help farm advisors train growers on how to best use these techniques. The UCD farm advisors' training meeting also included the use of disease models in scouting programs. Farm advisors met with Dr. Doug Gubler who addressed his research in this area and provided ideas for future projects.

RESULTS

Use of IPM programs that incorporated biological control
Demonstrations incorporating the use of biological control were successfully developed on four crops: poinsettia, lisianthus, gerbera, and stock. These demonstrations were useful to the growers and provided benchmark data for improving the most promising programs in future years.

Data showed mixed results, however, in terms of cost and commercial feasibility. Economically successful programs were developed in Ventura County on gerbera (Table 1) and poinsettia crops, and in Santa Barbara County on stock (Table 2). However, in Santa Cruz County, the gerbera biological control program was nearly 3X the cost of the conventional program; in San Diego County, the biological control program on poinsettias was also more expensive.

In addition, data showed mixed results in terms of efficacy. In Ventura County, the biological control program on poinsettias was effective, but in San Diego County, due to high whitefly pressure, the biological control program did not provide the control of the conventional treatment using imidacloprid (Marathon).

A combination of biological control, biopesticides, and reduced-risk pesticides was effective in controlling pests year-round on gerberas in Ventura County. Similarly, in Santa Cruz County, a combination of *Diglyphus* parasitoids and cyramazine (Citation) effectively controlled leafminer (Fig. 1). *Eretmocerus* parasitoids did not control whiteflies, but reduced-risk pesticides were effective and not disruptive to the leafminer parasites. However, in San Diego County, biological control on gerbera was only successful early in the season; later it lost efficacy with increasing thrips pressure. This nursery is planning to try again this year with *Beauveria bassiana* (Botanigard) for thrips control. They were not able to try this biopesticide in 1998 because of plant diseases related to a new hydroponic system, resulting in the use of incompatible fungicides.

Use of IPM programs using tospovirus monitoring

In general, our tospovirus monitoring programs provided significant information for the cooperating growers. Data from the indicator plants and from sticky cards showed where infested thrips sources were so that growers could focus their control efforts there; this approach helped to avoid unnecessary sprays, reducing pesticide use.

In San Diego County, data on ranunculus confirmed that high populations of thrips do not necessarily mean high disease inoculums, and vice-versa (Fig. 2). Growers who rely only on the use of sticky traps to manage tospoviruses are therefore at a disadvantage. Indicator plants were used to demonstrate to a kalanchoe grower that even though virus infested plants were still salable, relying on numerous sprays to control virus-infected thrips was not solving his problem because the tospovirus was being moved from the infested kalanchoe to other crops. The grower therefore eradicated infested kalanchoe plants and significantly reduced disease incidence in his nursery. In another greenhouse containing potted chrysanthemums, lisianthus, begonia, and cyclamen, the petunia indicator plants picked up a source of virus infection from a point outside the greenhouse. The grower is therefore screening this greenhouse to exclude these thrips.

In Santa Barbara County, data from directional traps was useful in identifying directional movement of thrips. In Ventura County, thrip populations and virus incidence were too low to pick up any useful information with the petunia plants. The grower is continuing the monitoring program, however, and it may prove useful when thrips populations increase later in the season.

Economic value of scouting programs

Data support that costs related to pest management were usually significantly reduced in the IPM programs with scouting, especially in the programs that did not emphasize the use of biological control. These cost reductions were achieved with no decrease in plant yield or quality. In fact, in some cases the quality and yield of crops produced were better due to more efficient timing and directing of pesticide applications. This resulted in fewer phytotoxicity problems and crop damage related to insect feeding and disease spread. Sample economic data from petunias in Ventura County (Table 3) and from roses in Santa Cruz County (Table 4) is presented in the Appendices.

Scouting workshops

To facilitate hands-on learning, each scouting workshop session was limited to 35 participants. In the nine workshops, we reached an audience of over 300. A survey, developed and disseminated at each workshop to measure adoption of IPM programs and other benefits of the program, showed very positive results. Survey results indicate that the project has been highly successful in making changes in the industry in pest management practices, and has resulted in over-all reduction in pesticide use.

Farm advisors' training.

The training and consulting was crucial in ensuring the success of this program. As a result, farm advisors were able to incorporate the latest techniques into their programs. They extended this information to clientele and were able to work more effectively at demonstration sites.

DISCUSSION, SUMMARY, AND CONCLUSIONS

The major objective of this project was to demonstrate to California flower growers that they can decrease pesticide usage, maximize economic returns, and produce high quality crops by using IPM programs which use established scouting procedures. To accomplish this goal and increase adoption of scouting programs in commercial settings, demonstration plots were set up in three regional ornamental production areas in 15 nurseries by the cooperating farm advisors and scouts trained by these advisors. We incorporated the use of biological control and the use of petunia plants as indicators of tospoviruses where feasible. Over 100 different flower crops were examined, and biological control programs were implemented on four of them. Scouts met weekly with the growers/pest management decision-makers. These face-to-face meetings not only were necessary to discuss the crop status and ascertain required control measures, but also to demonstrate the results and benefits of the program to the nursery cooperators, and ensure that they were sufficiently trained to continue the program when the project was completed. Pest management actions were based on the monitoring data. Whenever possible, reduced-risk pesticides, use of natural enemies, and biopesticides were used over conventional pesticides. The cost and quality of the IPM/scouting program was compared to conventional programs from records kept by the scout.

In addition to the demonstrations, nine regional scouting training workshops were held in 1998, reaching an audience of over 300. Each workshop was limited to 35 participants so that hands-on learning was fostered. Four of the workshops were conducted in Spanish, as well as English.

As a result of the face-to-face meetings with scouts at the demonstration sites, grower-cooperators learned how the monitoring methods worked, so that they could continue the scouting program when the demonstration terminated. They saw first-hand the results and benefits of the scouting programs. These positive results are similar to those reported by the authors concerning earlier scouting demonstration projects (Newman et al. 1996) and by University and extension personnel in other states involved with scouting demonstration projects (Ferrentino et al. 1993).

Due to the high success of the scouting program in demonstrating benefits (e.g. reduced pesticide use, improved plant quality, lower production costs), most cooperators are continuing to use the scouting program. Therefore, the project has been very successful in improving grower IPM practices, resulting in over-all reduction in pesticide use and in increasing adoption of IPM practices. Many growers have started scouting programs on their own as a result of participating in training meetings, attending scouting presentations, or reading publications developed by the authors, as evidenced by calls for more information to the cooperating farm advisors.

The best results were realized when growers and others involved in pest management in the nursery worked together with the scout as a team. Good communication was critical to the over-all success of the IPM program. Those nurseries that were set up to use spot application of pesticides (vs. spraying large areas in the greenhouse or field) and focused on the use of directed sprays (vs. spraying whole plant canopies) so that non-target areas were not included in the application, achieved the greatest reduction in pesticide use and economic savings.

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APPENDICES

Table 1. Comparison of gerbera pest management costs and pesticide use per acre per month using the grower's standard practice and biological control/IPM scouting.

	Standard Practice	*IPM Scouted*
Spray Gal Applied	**800**	**380**
Scouting Tools	**$ 7**	**$ 24**
Scouting Labor	**43**	**120**
Application Labor	**201**	**80**
Pesticide Costs	**744**	**125**
Biologicals	**—**	**528**
Release Labor	**—**	**18**
Total	**$995**	**$ 895**

Table 2. Comparison of field stock pest management costs and pesticide use per acre per month using the grower's standard practice and biological control/IPM scouting.

	Standard Practice	*IPM Scouted*
Spray Gal Applied	**350**	**100**
Scouting Tools	**$ —**	**$ 2**
Scouting Labor	**10**	**21**
Application Labor	**66**	**17**
Pesticide Costs	**164**	**55**
Biologicals	**—**	**107**
Total	**$ 240**	**$ 202**

Table 3. Comparison of petunia pest management costs and pesticide use per acre per month using the grower's standard practice and IPM scouting.

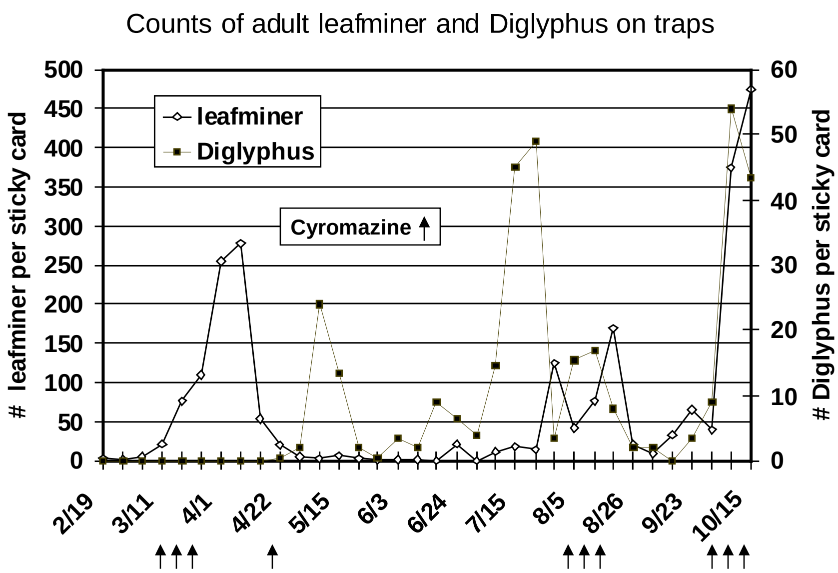
	Standard Practice	*IPM Scouted*
Spray Gal Applied	**325**	**25**
Scouting Tools	**$ 3**	**$ 12**
Scouting Labor	**22**	**87**
Application Labor	**54**	**4**
Pesticide Costs	**177**	**23**
Total	**$ 256**	**$ 126**

Table 4. Comparison of rose pest management costs and pesticide use using the grower's standard practice and IPM scouting.*

	Standard Practice	*IPM Scouted*
Spray Gal Applied	**393,880**	**290,000**
Scouting Costs	**$ —**	**$ 4,160**
Application Labor	**17,904**	**13,184**
Pesticide Costs	**80,288**	**44,885**
Total	**$ 98,192**	**$ 62,229**

***Total cost from 13 acres greenhouse cut roses**

Figure 1. A combination of the use of parasitoids and cyromazine effectively controlled leafminer on gerbera through most of the season.



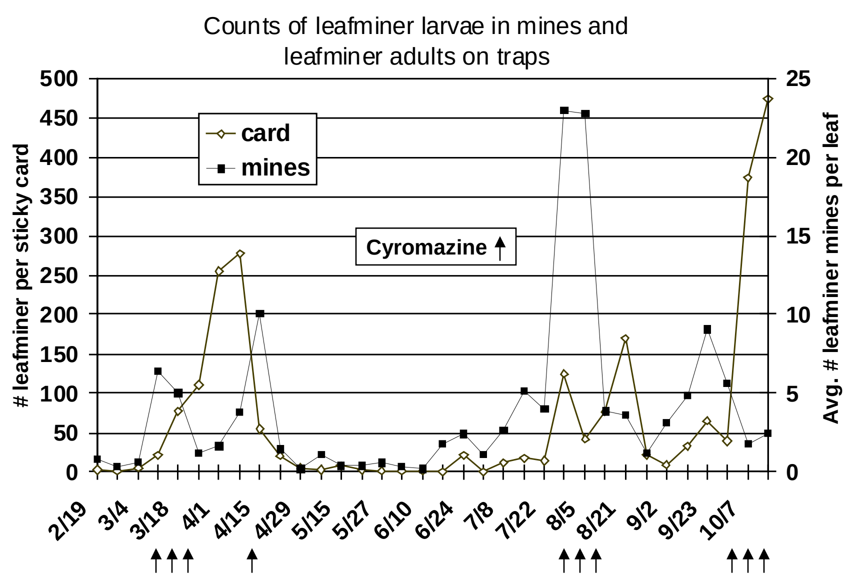
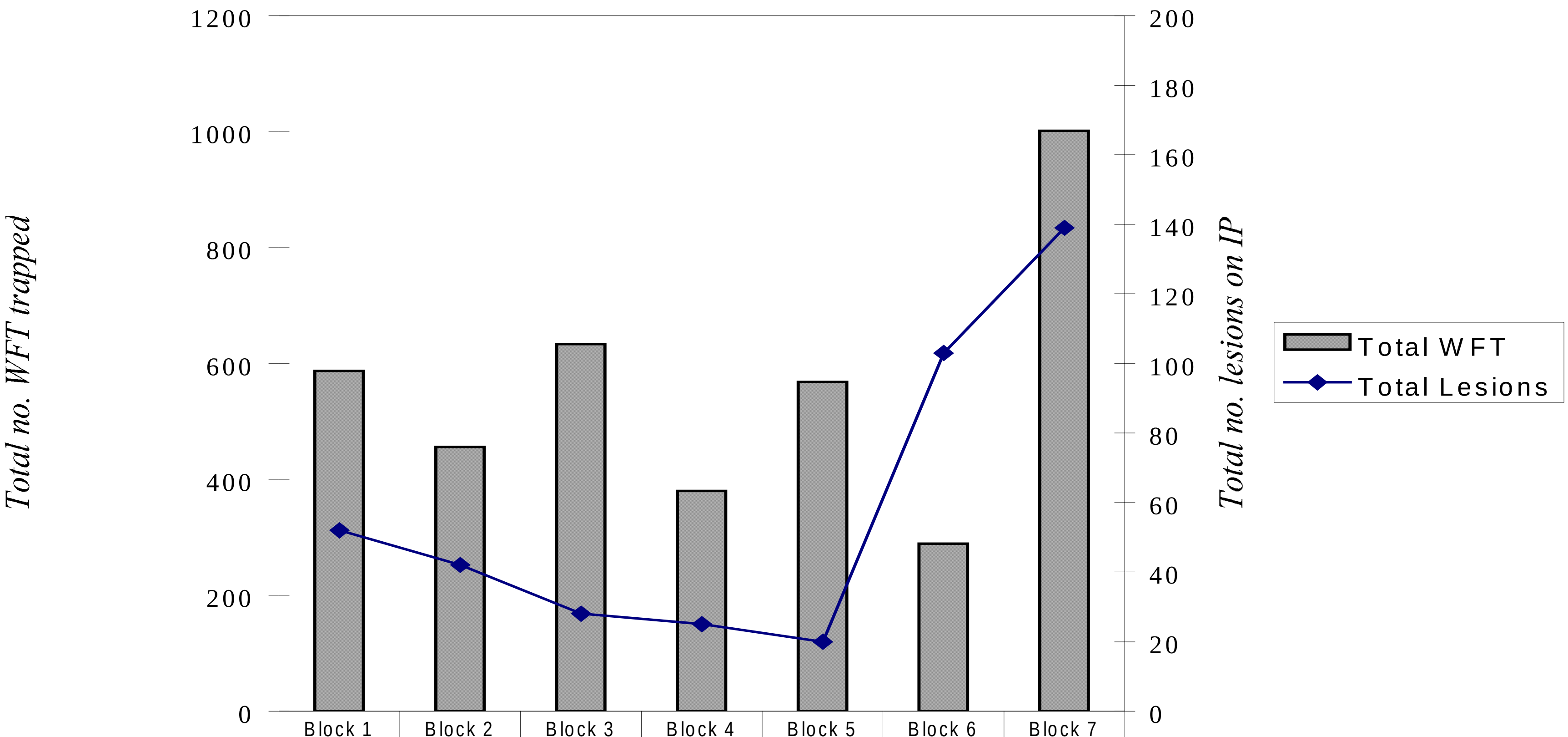


Figure 2. Comparison of total western flower thrips (WFT) to total lesions detected on petunia indicator plants in 7 ranunculus production blocks. Peak lesions occurred where low WFT were in Block 6 and low lesions occurred where there were high WFT in Blocks 3and 5. Only the infective thrips in the population can cause lesions on petunia plants. Therefore it is important to use indicator plants and not just spray when WFT are found on sticky cards.



	Block 1	Block 2	Block 3	Block 4	Block 5	Block 6	Block 7
Total WFT	587	456	633	380	568	289	1001
Total Lesions	52	42	28	25	20	103	139